

SECTION 1.0 - INTRODUCTION

1.1 Background

Carroll Engineering Corporation has prepared this Act 537 Sewage Facilities Plan Amendment #3 on behalf of Upper Dublin Township, in coordination with the Bucks County Water and Sewer Authority (BCWSA), to address the present and future sewage disposal needs of Upper Dublin Township. Specifically, this report focuses on the central portion of the Township, which is tributary to the Upper Dublin Wastewater Treatment Plant (UDWWTP) owned and operated by BCWSA.

The UDWWTP is an existing Sewage Treatment Plant serving Upper Dublin Township, located at 455 Delaware Drive, Fort Washington, PA. The Treatment Plant is approved to discharge into the Pine Run Creek up to 1.35 million gallons per day on a maximum monthly basis under a National Pollutant Discharge Elimination System Part 1 Permit (NPDES Permit No. PA0029441) issued December 1, 2014, and valid until November 30, 2019.

In order to better understand the existing hydraulic conditions within the UDWWTP Drainage Area, an analysis of the existing flow conditions in the three primary trunk sewers tributary to the Plant was completed using meter data collected during the first half of 2018. This data was then compared to Plant influent flow data.

Following the investigation of existing and projected sanitary sewer flows within the Upper Dublin Wastewater Treatment Plant drainage area (see Attachment 1), flow projections were broken down into five-year, ten-year, and ultimate projections. In accordance with BCWSA standard specifications, all EDU projections are based on 250 gallons per day per EDU.

This report has been prepared in accordance with 25 PA Code, Chapter 71 “Administration of Sewage Facilities Planning Program.”

1.2 Purpose and Objective

The Upper Dublin Wastewater Treatment Plant, located along Delaware Drive, is within a Special Flood Hazard Area designated by FEMA flood map number 42091C0289G, last revised on 3/2/2016. In its current condition, the wastewater treatment plant is not adequately equipped to meet the projected future growth demands in Upper Dublin Township. In order to properly meet these demands, this Act 537 Plan Amendment examines the feasibility of a number of alternative options moving forward.

Section 5.0 of this report identifies the three most feasible methods to handle projected flows from the UDWWTP service area. These options include expansion of the existing wastewater treatment plant, the construction of a sewage pumping station to divert flows to the Ambler WWTP, or no action. An in-depth exploration of the information compiled in Section 5.0 was then used to form the recommendation that is provided in Section 6.0.

In addition to forming a plan to meet the needs of the UDWWTP drainage area, adjustments to the service area are also being proposed as part of this report. The UDWWTP service area boundary line has been expanded in the vicinity of Craig-Y-Nos Avenue to accommodate the proposed low-pressure sanitary system to serve the neighborhood. In addition, the map (See Attachment No. 1) shows the Ambler Service Area encompassing the entire UDWWTP Service Area, which will be necessary if PADEP concurs with this report's recommended option (see Section 7.0).

SECTION 2.0 – EVALUATION OF PRESENT FLOWS

2.1 General Methodology

Analysis of the existing flow conditions in the three primary trunk sewers tributary to the Upper Dublin Wastewater Treatment Plant was completed using data collected in a 2018 meter study. That study included meters installed in each of the three primary interceptors (the Rapp Run, the Pine Run, and the Delaware Drive Interceptors) as well as a number of locations further upstream. The study lasted approximately five months.

Following the evaluation of each interceptor, the interceptor drainage areas were then further broken down by tax block. Existing flows in each tax block were calculated based on the flow model that was presented in the Upper Dublin Township Act 537 Text Amendment 2 (April 2004). The flows in Text Amendment 2 were originally calculated using a combination of commercial water use records, real estate data, and Township zoning and land development regulations. Existing flows and projections used from the flow model have been updated to account for zoning changes, subdivisions, and development projects that have been connected or modified since the original model was compiled.

Present flows were evaluated based on Equivalent Dwelling Units (EDUs) as the primary unit of measure. In all previous analyses, a single EDU equated to 220 gallons per day; however, since the Bucks County Water and Sewer Authority has gained ownership of the treatment plant and collection system, their standard of 250 gallons per day per EDU will be used moving forward, both in this report and in all future reports and analyses.

In this section, present flows being treated at the UDWWTP have been evaluated by aggregating flow data from the 2018 meter study, 2018 UDWWTP influent flow data and a breakdown of flows by tax block that is based on the previously submitted Text Amendment 2.

2.2 2018 Meter Study

In order to better understand the existing flow conditions in the Upper Dublin service area that flows to the Upper Dublin Wastewater Treatment Plant, a Meter Study, which included five metering locations, was conducted from January 20, 2018 through June 30, 2018. The locations of each of these meters are shown on the map included in Attachment 1 and the site reports in Attachment 2. Following the completion of the study, flow meter data was analyzed and compared to the daily precipitation. This helped to provide a better understanding of how inflow and infiltration may be affecting peak flows in the three primary trunk sewers located in the UDWWTP service area. This comparison of metered flows and precipitation has been provided in Attachment 3 of this report.

Of the five meters discussed above, the meters used as part of this study were labeled UD-1, UD-2, and UD-3. UD-1 was placed in the Rapp Run Interceptor while UD-2 was placed in the Pine Run Interceptor, both of which were located upstream of the treatment plant. Similarly, UD-3 was placed in the Delaware Drive Interceptor prior to its convergence with the other two interceptors. A summary of the data collected by each of these three meters has been provided in Table 1 below.

Table 1		
2018 Meter Study Interceptor Flow Summary		
Interceptor	Average Daily Flow (MGD)	Maximum Daily Flow (MGD)
Rapp Run Interceptor	0.304	0.728
Pine Run Interceptor	0.401	0.970
Delaware Drive Interceptor	0.257	0.955
Combined	0.962	2.653

During the meter study, the Upper Dublin Township service area experienced precipitation levels over nine inches higher than the 30-year average. Graphical analyses, provided in Attachment 3 of this report, shows that a number of the maximum daily flows can be associated with significant precipitation events and attributed to inflow and infiltration. In many cases, increases in flow are delayed following large scale storm events. In addition, large spikes during smaller events were noted a few days later when the ground was fully saturated. The Delaware Drive Interceptor experienced the largest spikes in flow, which were concentrated mostly around rain events. A graph for each flowmeter compared to precipitation for the duration of the study can be found in Attachment 3.

2.3 Existing Plant Flows

Following the completion of the 2018 Meter Study summarized above, the sum of the average and maximum daily flows observed were compared to the average daily influent flow data collected at the plant during the same period (January 20, 2018 through June 30, 2018).

Table 2		
Upper Dublin WWTP Daily Influent Flow Analysis		
Interceptor	Average Daily Flow (MGD)	Maximum Daily Flow (MGD)
January 2018	0.674	1.058
February 2018	1.021	1.650
March 2018	1.236	2.097
April 2018	0.907	1.32
May 2018	0.865	1.259
June 2018	0.826	1.411
Period Average	0.939	1.466

Differences in combined meter flows shown in Table 1 and the actual flows recorded at the UDWWTP as shown in Table 2 can be primarily attributed to the amplification of metering error that is a result of meter calibration.

The average plant flow of 0.939 MGD that was recorded during the 2018 Meter Study is not indicative of normal flows seen at the UDWWTP over the last five years. Table 2A below shows a cumulative average annual flow from the last five years of 0.692 MGD; 0.247 MGD less than the flows seen during the meter study. In order to better understand this departure, precipitation data was compiled for the same time period. During the meter study alone, 26.16 inches of rain was recorded; 2018 saw a total of 66.03 inches. With 21.35 inches of rain above the 10-Year average (2008-2018, 44.68”), the abnormally high flows seen at the UDWWTP in 2018 are believed to be result of one of the wettest years on recent record.

Year	Avg. Annual Flow (MGD)	Total Annual Precip. (in.)*
2013	0.680	49.80
2014	0.774	45.99
2015	0.646	42.26
2016	0.689	37.21
2017	0.670	35.90
Existing 5-Year Average	0.692	42.23

*Precipitation data from the Northeast Philadelphia Airport Weather Station (KPNE) via Pennsylvania State Climatology Data.

2.4 Existing Flows by Tax Map Block

Following the evaluation of the three primary trunk sewers within the UDWWTP service area, flow analysis was taken a step further by breaking each trunk sewer drainage area into tax map blocks. Existing flows in each tax block were estimated based on the flow model that was included in the Upper Dublin Township Act 537 Text Amendment 2 (April 2004). The flows in Text Amendment 2 were originally calculated using a combination of commercial water use records, real estate data, and Township zoning and land development regulations. The existing model flows were then updated to account for zoning changes, and subdivisions and land development projects that were connected since the original model was compiled.

Block	Existing Flows (EDU's)	Residential	Non- Residential
3A	8	x	
5B	23	x	
5C	9	x	
5D	7	x	
5F	49	x	
5G	22	x	
5L	15	x	
6	41	x	
6A	40	x	
6B	33	x	
7	68	x	
8	60	x	
8A	29	x	
8B	34	x	
8D	66	x	
8E	146	x	
8F	73	x	
8G	23	x	
8H	5	x	
8J	34	x	
10	9	x	
10C	14	x	
26	0	x	
48	14	x	
48C	37	x	
48D	51	x	
48E	38	x	
48F	43	x	
51	131	x	
51A	44	x	
51B	17	x	

Table 3A			
Existing Wastewater Flows – Pine Run Drainage Area			
Block	Existing Flows (EDU's)	Residential	Non-Residential
8	1	X	
8F	2	X	
8H	26	X	
9	110	47	63
9A	73	X	
10	178	80	98
10A	79	X	
10B	78	X	
11	85	4	8
11A	26	X	
11B	32	X	
11C	33	X	
11D	48	X	
12	171	1	170
12A	125	X	
12B	93	X	
12C	66	X	
12D	66	X	
13	7	5	2
50	12		X
51	61		X
52	381		X
54	0		X
56	24		X
70	26	6	20
71	12	X	
72	1	X	

Table 3B			
Existing Wastewater Flows – Delaware Drive Drainage Area			
Block	Existing Flows (EDU's)	Residential	Non-Residential
48	8	x	
48G	30	x	
48H	21	x	
49	125	7	118
50	372		x
51	25		x

2.5 Summary of Existing Flows

Taking into consideration the existing 5-Year average annual flows of 0.692 MGD (calculated in Table 2A) and the average monthly plant flows of 0.939 MGD (recorded in the first six months of 2018), it has been determined that a weighted average is most representative of existing flows at the UDWWTP. Moving forward, projected flows will be based on a weighted average existing flow of 0.80 MGD.

Table 4		
UDWWTP Act 537 Plan Summary of Existing Flows		
Existing WWTP Flows	Weighted 5-Year Average	0.80 MGD
	Max Month	1.20 MGD
	Max Hour	2.40 MGD

SECTION 3.0 – EVALUATION OF FUTURE FLOWS

3.1 General Methodology

In order to project future sanitary sewer flows most accurately within the Upper Dublin Wastewater Treatment Plant drainage area (see Attachment 1) flow projections have been broken down into five year, ten year, and ultimate flows. Similar to the evaluation of existing flows, projected flows are based on a 250 gallon per day per Equivalent Dwelling Unit (EDU) per Bucks County Water and Sewer Authority standards.

3.2 Five (5) Year Projections

Five (5) Year Projections are primarily based on the Upper Dublin Wastewater Treatment Plant Chapter 94 Wasteload Management Report covering calendar Year 2017. Promenade at Upper Dublin located at the intersection of Welsh Road and Dreshertown Road is the only project that differs from the projections presented in the 2017 Chapter 94 Report. Three hundred and eighty (380) EDUs were allocated for the Promenade when the aforementioned report was compiled; however, now that the planning phase for the project has been completed, the allocation has been revised to 418 EDUs.

2017 CHAPTER 94 REPORT 5-YEAR PROJECTIONS	
Project Name	Projected EDUs
1402 Highland Ave. (Brasch)	1
Cutler (Zeiger)	36
Dresher Estates Expansion	12
Bauman Drive	1
1020 Limekiln	1
1445 Susquehanna Rd.	1
Enclave at the Promenade	115
Promenade at Upper Dublin	380*
JEA Senior Living (Dresher Care)	66

*The planning phase is now complete, and the project was officially allocated 418 EDUs. The 2018 Upper Dublin WWTP Chapter 94 Report will reflect this change.

3.3 Ten (10) Year Projections

Ten (10) Year Projections are based on projections that were made in the Flow Model submitted with the April 2004, Act 537, Amendment 2. Numbers from the 2004 report were updated using current project knowledge and information from all Chapter 94 report projections submitted since 2001. Updates include the addition of projects that were proposed or expanded within the next 10 years.

3.4 Ultimate Projections

Ultimate Projections were determined using the summation of the five and ten year projections discussed above and the additional projections based on zoning changes explained in this section. The zoning projections considered in this report are based on changes in zoning boundaries and township zoning ordinances since the last Act 537 Amendment. These changes allow for additional development on certain parcels throughout the UDWWTP Service Area. In addition to the changes already in place, there are also a number of changes that are being proposed to encourage further development in certain areas of the Township.

Parcels which have been assigned a revised zoning district due to Township zoning changes put in place since Amendment 2, were used as the primary source of data for the Ultimate Projections provided in this section. The Employment Center District, formerly zoned as Limited Industrial District and now proposed to be the Greater Fort Washington District (GFW), is the primary zone of interest for this 537 Amendment because of the large potential for expansion in areas rezoned to this new designation. Building limitations laid out in the current Upper Dublin Zoning Ordinance for the Employment Center District and the proposed Ordinance as it relates to the GFW District were used to determine the ultimate number of EDUs that could possibly be put on each parcel in the new district.

To more accurately estimate the maximum number of EDUs that could be added to the Upper Dublin Wastewater Treatment Plant service area based on zoning changes, the 2004 zoning map was compared to the current zoning map (see Attachment 5). From that comparison, a list of all parcels that have been assigned a new zoning district was compiled, which included the previous zoning designation and the current/future zoning designation. Using a series of equations derived from the relevant ordinances located in the Upper Dublin Township PA Code of Ordinances Chapter 255, Articles VII through XVIII and proposed Article XXXVIII (last revised 9/6/18) as it relates to the Greater Fort Washington District, a maximum possible number of EDUs per parcel was determined.

Zoning changes and descriptions of how maximum possible buildout was calculated for each zoning district are presented below:

Using GIS parcel data obtained from Montgomery County, the parcel size of all parcels rezoned as Residential A was first multiplied by a standard 0.75 to account for open space requirements, floodplain presence, wetlands and any other natural features that would limit buildable area.

For parcels previously within A-1 or A-2 Residential Districts that were changed to Residential District A: The remaining lot area, after removing a standard 25%, was divided by the Zone A minimum lot area of 26,000 sf to determine the number of potential subdivisions possible. A standard 1 EDU was then subtracted from the possible number of subdivisions to account for the existing home on the lot. The remaining number of EDUs, if any, represents the number of additional future EDUs possible on a given parcel.

For parcels previously zoned as A or A-2 Residential Districts that were changed to A-1: The remaining lot area, after removing a standard 25%, was divided by the Zone A-1 minimum lot area of 22,000 sf to determine the number of potential subdivisions possible. A standard 1 EDU was subtracted from the possible number of subdivisions to account for the existing home on the lot. The remaining number of EDUs, if any, represents the number of additional future EDUs possible on a given parcel.

For parcels previously zoned as A Residential or Industrial that were changed to Residential District B: The remaining lot area, after removing a standard 25%, was divided by the Zone B minimum lot area of 22,000 sf to determine the number of potential subdivisions possible. A standard 1 EDU was subtracted from the possible number of subdivisions to account for the existing home on the lot. The remaining number of EDUs, if any, represents the number of additional future EDUs possible on a given parcel.

For parcels previously zoned as A Residential that were changed to Multi-Dwelling District (MD): Within the Multi-Dwelling District, the minimum tract size is three acres so all parcels rezoned as MD with less than three acres of land area are considered fully built out with no potential for expansion. For the remaining lots, acreage was multiplied by 0.15 in accordance with the MD Zoning requirement of a maximum building coverage of 15%. Buildable acreage was then multiplied by a factor of eight based on a maximum of eight individual units per buildable acre.

For parcels previously zoned as LIM that were rezoned as Employment Center District (EC) and now proposed as GFW:

The minimum lot size in the Employment Center District on each parcel is two (2) acres with the maximum building size equal to 20% of the lot size plus 2.5% for every acre. Accounting for those constraints, it was determined that the maximum building footprint is 0.5 acres or 21,780 square feet, if a lot is subdivided into the smallest possible increments. To obtain an EDU count per floor, the overall square footage was divided by 200 SF per person, based on the average square foot of space per office generally accepted by industry standards. This equated to 109 people per floor. The PADEP Water Supply Manual states each office person will use approximately 15 gallons of water per day, which equates to 1,635 gallons per floor per day. This was then divided by 250 GPD to calculate a maximum number of seven (7) EDUs per floor.

A majority of the current Employment Center District is proposed to be re-zoned as the Greater Fort Washington (GFW) District.

In the proposed GFW District, the primary determining factor for development potential is the allowable building height. Allowable building height has been determined by Upper Dublin Township and Metz Engineers in the attached Height Restrictions Map-1, last revised September 6, 2018 (see Attachment 5). As shown on the Height Restrictions Map, the GFW District is further divided into five height area categories: 35-feet (3 stories), 50-feet (4 stories), 60-feet (5 stories), 75-feet (6 stories), and 75-feet to 120-feet (11 stories). Each parcel in the GFW District was reviewed using aerial imagery to determine if the lot has already been developed and if so, to approximate the existing building size. Using that information and

parcel size data, the number of additional stories that could potentially be constructed if the parcel were to be redeveloped was then determined.

Because of its proximity to the Pine Run, construction limitations dictated in the Upper Dublin Township Floodplain Ordinance were considered when calculating the maximum possible number of stories that could be built on each parcel within the GFW District. Using 2018 floodplain mapping data provided by FEMA, all parcels partially located inside of the designated floodplain area and having the potential for further development were identified. For these parcels, the number of EDUs associated with a single floor were removed from the ultimate projections based on the assumption that if the parcel were to be redeveloped under the Township Floodplain Ordinance, the first floor would be designated for parking only.

Interceptor	Additional EDUs
Rapp Run Drainage Area	308
Pine Run Drainage Area	2,514
Delaware Drive Drainage Area	2,074
Total Projected Flows	4,896

*See Attachment 8 for a complete breakdown of projections based on zoning changes.

3.5 Ultimate Projected Flows by Tax Map Block

In the tables below, flows projected in the UDWWTP Service area have been further broken down by tax map block. Ultimate projects are the sum of the 5-Year and 10-Year projections and, where applicable, additional projections based on zoning changes.

Block	5-Year	10-Year	Ultimate
5B	1	0	1
5D	0	8	8
5F	0	18	18
5G	0	11	11
5L	0	3	3
6	0	18	18
6B	0	1	1
7	0	5	5
8	0	13	13
48	0	13	13
50	0	0	308
51A	1	0	1
Totals	2	90	400

Table 6A			
Future Wastewater Flows – Pine Run Drainage Area			
Block	5-Year	10-Year	Ultimate
9	0	13	16
10	66	5	71
11	36	40	94
12	418	146	565
12A	0	0	55
12B	0	0	13
12D	0	67	92
13	0	0	1
50	0	21	168
52	0	324	2508
54	0	8	64
70	0	1	6
70F	0	0	6
71	1	0	1
Totals	521	625	3,660

Table 6B			
Future Wastewater Flows – Delaware Drive Drainage Area			
Block	5-Year	10-Year	Ultimate
4J	0	0	42
38T	0	0	140
48G	0	1	1
49	0	68	1300
50	0	125	785
51	1	61	62
Totals	1	255	2,330

3.6 Summary of Projected Flows

Table 7 below reiterates the existing UDWWTP flows that were presented in Section 2.0 and summarizes the projected flows that were discussed in this Section. Projected maximum month flows were calculated by taking the existing maximum month (1.20 MGD) and adding 1.5 times the average projected flows. Projected maximum hour flows were calculated by adding 2.5 times the average projected flow to the existing maximum hourly flow (2.40 MGD).

Table 7		
UDWWTP Act 537 Plan Summary of Projected Flows		
Existing WWTP Flows	Weighted Average	0.80 MGD
	Max Month	1.20 MGD
	Max Hour	2.40 MGD
		Cumulative Projected
Average Projected	0.13 MGD	0.93 MGD
5-Year Flows	Maximum Month	1.40 MGD
	Maximum Hour	2.73 MGD
Average Projected	0.37 MGD	1.17 MGD
10-Year Flows	Maximum Month	1.76 MGD
	Maximum Hour	3.34 MGD
Average Projected	1.60 MGD	2.40 MGD
Ultimate Flows	Maximum Month	3.60 MGD
	Maximum Hour	6.40 MGD